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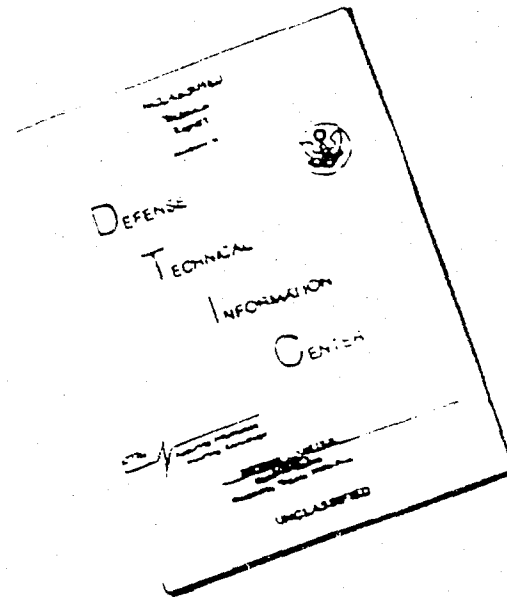


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R-885 FUNGUS TESTS ON POLYVINYL CHLORIDE FILMS PLASTICIZED WITH THREE PLASTICIZERS

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REPORT NO. R-889



FUNGUS TESTS ON POLYVINYL CHLORIDE FILMS  
PLASTICIZED WITH THREE PLASTICIZERS

By

Sigmund Berk

SECOND REPORT

PROJECT TMI-15360

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PITMAN-DUNN LABORATORY  
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January 1949

REPORT NO R-889

FUNGUS TESTS ON POLYVINYL CHLORIDE FILMS PLASTICIZED WITH  
THREE PLASTICIZERS

SECOND REPORT

PROJECT TM-15360

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### OBJECT

To determine the susceptibility to fungus growth of polyvinyl chloride films plasticized with dibutyl sebacate, dioctyl phthalate, and butadiene-acrylonitrile, and to determine the effect of the fungus growth on the tensile strength and percentage elongation of the plastic films.

### SUMMARY

Fungus resistance and tensile strength tests were conducted on polyvinyl chloride plastic films formulated with three plasticizers. The film with dibutyl sebacate as the plasticizer was very susceptible to *Aspergillus flavus* and to a species of *Penicillium* and *Trich. term.* The dibutyl sebacate plasticized film which was inoculated with the species of *Trichoderma* showed a large increase in the tensile strength and a significant decrease in the percentage elongation. The increase in tensile strength is attributed to the removal of the plasticizer from the film by the mold.

The polyvinyl chloride films formulated with dioctyl phthalate or butadiene-acrylonitrile as the plasticizers showed only slight susceptibility to the species of *Trichoderma* used. At the end of a 6 weeks' incubation period, the two plastic films exhibited only insignificant changes in the tensile strength and percentage elongation.

In so far as resistance to fungi is concerned, it is concluded that dioctyl phthalate and butadiene-acrylonitrile are satisfactory plasticizers for this polyvinyl chloride plastic formulation.

### AUTHORIZATION

OO 471.873/636, CRDTM: FA 471.8732/5655, 20 Oct 1948

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### Table I

- " II
- " II a
- " III
- " III a
- " IV
- " IV a

Figs 1, 2, 3

## I. INTRODUCTION

Plastic films were cast from three formulations containing a mixture of polyvinyl chloride resin, plasticizer, polarized oil, light inhibitor, and methyl isobutyl ketone. These dispersions were prepared by a new method involving electronic heating. The polyvinyl chloride dispersion is used hot (80°C-100°C). After casting, the films were aged for two weeks at room temperature to allow the escape of solvents.

The intended use of the polyvinyl chloride dispersion is as a hot dip to close perforations in cartridge cases. Since it is desired that the plastic be fungus resistant, the film plasticized with dibutyl sebacate, the first film available, was tested for susceptibility to mold and possible fungistatic properties (Test 1). Additional polyvinyl chloride plastics plasticized with dioctyl phthalate, or butadiene-acrylonitrile were also rated for their susceptibility to *Trichoderma* sp. and the effect of such mold growth on the tensile strength and percentage elongation of the films (Tests 2 to 4, inclusive). The plastic formulations containing dibutyl sebacate or dioctyl phthalate had 20% solids. The third formulation containing butadiene-acrylonitrile plasticizer had 15% solids.

Dumb-bell specimens 6" long (Fig 20), having a constriction  $1\frac{1}{2}$ " wide and 2" long, were cut from the cast films with a metal die. (1) The dumb-bell specimens were then conditioned at room temperature for an additional two weeks prior to exposure to mold tests.

## II. METHODS AND RESULTS

### A. Susceptibility to Mold Growth and Fungistatic Properties of a Polyvinyl Chloride Film Plasticized with Dibutyl Sebacate (Test 1).

Forty-ml portions of mineral salts agar (2) with and without 1% dextrose were poured into 16-ounce square bottles. The bottles

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(1) Federal Specification ZZ-K-601a, 25 June 1940, "Rubber Goods; General Specifications (Methods of Physical Tests and Chemical Analyses)."

(2)	$K_2HPO_4$	0.7 g.	$FeSO_4 \cdot 7H_2O$	0.002 g.
	$KH_2PO_4$	0.7	$ZnSO_4 \cdot 7H_2O$	0.002
	$MgSO_4 \cdot 7H_2O$	0.7	$MnSO_4 \cdot H_2O$	0.001
	$NH_4NO_3$	1.0	Agar (Difco)	15.0
	NaCl	0.005	Distilled water	1000.0 ml

containing the medium were sterilized at 15 lbs pressure for 20 minutes and placed on their sides. The pH of the autoclaved dextrose-free medium was 6.4. Six-inch tensile specimens of the plastic film plasticized with dibutyl sebacate were placed on the solidified medium in the bottles (Fig 1A).

Three day old cultures of *Penicillium* sp. U.S.D.A 1336.2, *Trichoderma* sp. FA 69, and *Aspergillus flavus* SN-3 growing on Difco potato dextrose agar were used as a source of inoculum. Spore suspensions were prepared by scraping the sporulating surface of the culture with a flamed platinum needle and depositing the spore charge into flasks containing glass beads and 25 ml sterile distilled water. The flasks were agitated to break up spore clumps, and the specimens were inoculated by pipetting 1 ml of the pure suspensions onto the surface of the specimen and the agar medium. Four samples were used with each type of agar and four samples served as uninoculated controls. The bottles containing the samples were incubated for 3 weeks in a constant temperature room maintained at  $29.4^{\circ}\text{C} \pm 0.6^{\circ}\text{C}$ .

Table I shows that the polyvinyl chloride plastic plasticized with dibutyl sebacate is very susceptible to 3 species of fungi when incubated on a non-nutrient mineral salts agar. In this test, the source of carbon for the growth of the fungi is furnished by the plastic sample. The National Bureau of Standards and the British Ministry of Supply<sup>(3)</sup> have reported that pure polyvinyl chloride resin is not susceptible to fungal growth. Dibutyl sebacate has been reported by the National Bureau of Standards and the Naval Research Laboratory<sup>(3)</sup> as moderately susceptible to fungi. The extreme susceptibility to fungus growth of this plastic formulation is attributed to the plasticizer.

The specimens incubated on the mineral salts agar with 1% dextrose produced no inhibition of fungus growth on the medium or on the edges of the specimens. This plastic formulation is therefore considered not fungicidal.

#### B. Susceptibility to *Trichoderma* sp. and the Effect of the Mold Growth on the Tensile Strength and Percentage Elongation of Polyvinyl Chloride Films Plasticized with Three Plasticizers.

##### 1. Dibutyl Sebacate (Test 2)

To determine the effect of fungus growth on the tensile strength of the polyvinyl chloride film plasticized with dibutyl

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(3) Summary Technical Report of the Tropical Deterioration Administrative Committee, NDIC, "Tropical Deterioration of Equipment and Materials", Vol 1, Chapter 5, 1946

sebacate, 18 six-inch dumb-bell test strips of the plastic film were placed on solidified non-nutrient mineral salts agar in square bottles, as described under Test 1. Inoculation of the test strips was effected by pipetting one ml of an aqueous spore suspension of *Trichoderma* sp. FA69 onto the specimens (Table II, Group A).

An experiment was also conducted to determine the effect of the incubation method, in the absence of fungus growth, on the tensile strength of the plastic strips. A pellet (approximately 0.13 gms) of paraformaldehyde, a volatile fungicide, was placed in a 10 ml beaker and added to each square bottle containing the solidified mineral salts agar (Table II, Group B). The 17 plastic samples comprising this group were not inoculated. Both groups of plastic strips were incubated for 44 days in a constant temperature room maintained at  $29.4^{\circ}\text{C} \pm 0.6^{\circ}\text{C}$ .

Table II shows that the strips of polyvinyl chloride plasticized with dibutyl sebacate (Group A) are very susceptible to the species of *Trichoderma*. Maximum mold growth on the samples incubated without a fungicide occurred after a two week period of incubation. Figure 1B shows that the dibutyl sebacate plasticized film is covered with a dense fungus mat after 3 weeks' incubation.

The fungicide, paraformaldehyde, was not completely effective in inhibiting the growth of contaminating molds present on the plastic strips. Five of the samples had slight to heavy mold growth. More recent work with propylene oxide as a mold-inhibitor for electrical paper tapes incubated in square bottles shows this chemical to be a more effective volatile fungicide.

At the end of the incubation period both groups of samples were removed from the bottles. The dumb-bell test pieces were dipped in a 0.1% aqueous solution of mercuric chloride for 2-3 minutes, rinsed in tap water, and dried at room temperature for 24 hours. After conditioning for 48 hours at  $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$  and  $50\% \pm 2\%$  relative humidity, the tensile strength and percentage elongation were determined with a Scott Tensile Tester. Table IX lists the tensile strengths and percentage elongations of the plastic samples. The dumb-bell strips inoculated with the species of *Trichoderma* (Group A) had a mean tensile strength value of 3462 lbs per square inch, as compared with 2119 for the uninoculated, unincubated controls (Group C), and 1833 for the uninoculated controls incubated with paraformaldehyde (Group B). In terms of percentage change, Group A had increases of 59.6% over Group B controls (incubated with paraformaldehyde) and 66.4% over Group C controls (not incubated). The large increase in the tensile strength of the specimens with mold growth is probably due to the removal of plasticizer by the species of *Trichoderma* used. Based on Student's *t* table, all these gains are significant at the .01 level. Additional evidence that mold growth produces an increase in tensile strength may be seen in Table II (Group B). The plastic strips that had mold

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growth in Group B also had the highest tensile strength values. The increase in the tensile strength of the plastic insulated with the species of *Trichoderma* may be attributed to the destruction or absorption of the plasticizer or some other constituent of the plastic film by the species of mold used.

The plastic samples insulated with the paraformaldehyde had a loss in tensile strength of 13.9% as compared with the uninsulated and uninsulated controls. Based on Student's t table, this loss is not significant at .05 level as  $P = .08$ . However, if only those samples which did not have mold growth (Table IX, Group B) are included in the calculations, the loss in tensile strength is 26.9% over the uninsulated controls. This loss is significant at the .01 level and it appears that the paraformaldehyde did have an effect on the tensile strength of the plastic film.

The plastic dumb-bell specimens insulated with the species of *Trichoderma* had a mean percentage elongation of 118.9% as compared to 34.9% for the uninsulated controls and 20.9% for the uninsulated controls insulated with the paraformaldehyde. In terms of percentage change, Group A had a loss of 99.0% over Group B controls and 67.1% loss over Group C controls. The specimens insulated with the paraformaldehyde had a loss of 18.1% over Group C controls. If only those samples free from mold growth (Table IX, Group B) are included in the calculations, there is a loss of 18.6% in percentage elongation. Based on Student's t table, all the losses are significant at the .01 level. The losses in percentage elongation of the plastic film insulated with the species of *Trichoderma* may be attributed to the removal of plasticizer by the fungi.

### 3. Diethyl Phthalate (Test 3)

Since the polyvinyl chloride plasticized with dibutyl sebacate was found very susceptible to mold growth in Test 2, a formulation containing diethyl phthalate as the plasticizer was obtained. The National Bureau of Standards (1) found diethyl phthalate resistant to mold growth. Six-inch dumb-bell tensile specimens of the plastic film were placed on mineral salts agar and inoculated with *Trichoderma* sp. F469, as described in Tests 1 and 2.

Table III shows the susceptibility of the polyvinyl chloride plasticized with diethyl phthalate to mold growth after the 6 week period of incubation. The extent of mold growth on the films varied from none to slight (Fig 2). The substitution of diethyl phthalate for dibutyl sebacate decreased the susceptibility of the polyvinyl chloride to mold growth.

Tensile strength tests were conducted on the conditioned plastic strips, as described in Test 2. Table III lists the tensile

growth in Group B also had the highest tensile strength values. The increase in the tensile strength of the plastics inoculated with the species of *Trichoderma* may be attributed to the destruction or absorption of the plasticizer or some other constituent of the plastic film by the species of mold used.

The plastic samples incubated with the paraformaldehyde had a loss in tensile strength of 13.5% as compared with the uninoculated and unincubated controls. Based on Student's t table, this loss is not significant at .05 level as  $P = .08$ . However, if only those samples which did not have mold growth (Table II, Group B) are included in the calculations, the loss in tensile strength is 26.9% over the unincubated controls. This loss is significant at the .01 level and it appears that the paraformaldehyde did have an effect on the tensile strength of the plastic film.

The plastic dumb-bell specimens inoculated with the species of *Trichoderma* had a mean percentage elongation of 112.9% as compared to 342.9% for the uninoculated controls and 280.9% for the uninoculated controls incubated with the paraformaldehyde. In terms of percentage change, Group A had a loss of 59.8% over Group B controls and 67.1% loss over Group C controls. The specimens incubated with the paraformaldehyde had a loss of 18.1% over Group C controls. If only those samples free from mold growth (Table II, Group B) are included in the calculations, there is a loss of 18.6% in percentage elongation. Based on Student's t table, all the losses are significant at the .01 level. The losses in percentage elongation of the plastic film inoculated with the species of *Trichoderma* may be attributed to the removal of plasticizer by the fungi.

## 2. Dioctyl Phthalate (Test 3)

Since the polyvinyl chloride plasticized with dibutyl sebacate was found very susceptible to mold growth in Test 2, a formulation containing dioctyl phthalate as the plasticizer was obtained. The National Bureau of Standards<sup>(3)</sup> found dioctyl phthalate resistant to mold growth. Six-inch dumb-bell tensile specimens of the plastic film were placed on mineral salts agar and inoculated with *Trichoderma* sp. FA69, as described in Tests 1 and 2.

Table III shows the susceptibility of the polyvinyl chloride plasticized with dioctyl phthalate to mold growth after the 6 week period of incubation. The extent of mold growth on the films varied from none to slight (Fig 2). The substitution of dioctyl phthalate for dibutyl sebacate decreased the susceptibility of the polyvinyl chloride to mold growth.

Tensile strength tests were conducted on the conditioned plastic strips, as described in Test 2. Table III lists the tensile

strength and percentage elongation of the plastic strips uninoculated and inoculated with the species of *Trichoderma*. The dumb-bell tensile strips inoculated with mold had a mean tensile strength value of 2124 lbs per square inch, as compared with a value of 2264 for the uninoculated and uninoculated controls. In terms of percentage change over the uninoculated controls, the plastics inoculated with the mold had a 6.2% loss in tensile strength. Based on Student's t table, this loss is not significant at the .01 level but significant at .05 level. There was a 4.8% loss in the mean percentage elongation of the specimens inoculated with mold. This loss is not significant at the .05 level.

### 3. Butadiene-Acrylonitrile (Test 4)

The plastic film plasticized with dioctyl phthalate also had properties which were undesirable for its intended use. A formulation was, therefore, obtained which had about 50% polyvinyl chloride and 50% butadiene-acrylonitrile as the plasticizer. The solids amounted to 15%. No information is available on the fungus resistance of this plasticizer. Dumb-bell tensile specimens of this plastic were inoculated with the species of *Trichoderma* and incubated on mineral salts agar, as described in Test 2.

The substitution of butadiene-acrylonitrile for dioctyl phthalate as a plasticizer did not increase the susceptibility of the plastic film to mold growth (Table IV). In Fig 3B, the tensile plastic strip has a trace of growth of the species of *Trichoderma*. Table IV also lists the tensile strength and percentage elongation of the specimens uninoculated and inoculated with mold. The mean tensile strength of the specimens inoculated with the *Trichoderma* was 9.9% higher than the uninoculated controls. This gain in tensile strength is significant at the .05 level but not significant at the .01 level. There was no significant difference in the mean percentage elongation between the inoculated specimens and the controls.

## III. CONCLUSIONS

1. A polyvinyl chloride film plasticized with dibutyl sebacate is highly susceptible to mold growth. The mold growth produces a large increase in the tensile strength and a large decrease in the percentage elongation of the plastic film.

2. Polyvinyl chloride plastic films plasticized with dioctyl phthalate or butadiene-acrylonitrile may be considered mold-inert. The films plasticized with these two plasticizers had no appreciable change in the tensile strength and percentage elongation after 6 weeks' incubation with the species of *Trichoderma*.

TABLE I

Susceptibility to Mold Growth of a Polyvinyl Chloride Plastic Film Containing Dibutyl Sebacate as the Plasticizer and Incubated at  $29.4^{\circ} \pm 0.6^{\circ}\text{C}$  for 3 Weeks on Mineral Salt Agar Without and With 1% Dextrose

<u>Inoculated with</u>	<u>Medium</u>		<u>Extent of Mold Growth<sup>1</sup> (Average of 4 samples)</u>
	<u>M-Mineral Salts Agar</u>	<u>D-Mineral Salts Agar plus 1% Dextrose</u>	
Uninoculated Control	M		1
	D		3
Penicillium sp. USDA #1336.2	M		4
	D		3
Trichoderma sp. PA69	M		3-4
	D		3-4
Aspergillus flavus SN-3	M		3
	D		1

<sup>1</sup> Code for fungus growth:

1 - up to 10% of surface moldy

2 - 10% to 40% " " "

3 - 40% to 75% " " "

4 - 75% to 100% " " "



TABLE II

Effect of the tensile strength and percentage elongation of a polymer on the elongation of a polymer film elongated with manual pressure.

1. The tensile strength and percentage elongation of the polymer film were determined for all days of thermal aging without (Group A) and with transformation (Group B).

Group B (with transformation), not yet elongated

Sample	Days	Average thickness (mm)	Tensile strength (kg/cm <sup>2</sup> )	% Elongation	Sample Number	Weld Score	Average thickness (mm)	Tensile strength (kg/cm <sup>2</sup> )	% Elongation
1	1	14	1122	207.5	25	1	12.5	2115	312.5
2	2	13	507	300	25	4	12.5	2500	312.5
3	3	17.5	2183	207.5	27	0	11	1595	275
4	4	5	4400	52.5	29	0	14	1250	312.5
5	5	17	3234	50	29	0	14.5	1125	297.5
6	6	19	4779	25	30	0	14.5	1180	312.5
7	7	16.5	2073	25	31	0	15.5	1275	297.5
8	8	6	7500	52.5	32	0	12	2375	312.5
9	9	6	1373	25	33	0	14	1285	275
10	10	22.5	1115	12.5	34	4	12	2375	312.5
11	11	24	2377	32.5	35	0	11.5	2719	297.5
12	12	6	3395	175	36	0	11	2909	312.5
13	13	30	3250	50	37	0	12	1666	275
14	14	17.5	1340	100	38	0	14.5	1371	300
15	15	12	4160	75	39	0	12	2166	312.5
16	16	17	2705	125	40	0	13.5	1791	287.5
17	17	20	2000	52.5	41	0	10	1900	350
18	18	26	2153	275	42	0	10		

1.  $\bar{x} = 352.8$   $\sigma = 1003$   $n = 17$   $\bar{x} = 1039.6$   $\sigma = 601$   $\bar{x} = 200.5$   $\sigma = 41$

2.  $\bar{x} = 219.2$   $\sigma = 132$   $\bar{x} = 342.9$   $\sigma = 35$

1. Data for fungus growth: 0 = no visible growth  
1 = up to 10% of surface moldy  
2 = 10 - 40%  
3 = 40 - 75%  
4 = 75 - 100%

2. Thicknesses are those of specimens before elongation

TABLE II a

Comparison of Mean Tensile Strength and Percentage Elongation of Polyvinyl Chloride Film Plasticized with Dibutyl Sebacate and Incubated on Mineral Salts Agar

	Group A <sup>1</sup> $\bar{x}$ (mean)	Group A compared to Group B		Group A compared to Group C		Group B compared to Group C	
		Group B <sup>1</sup> $\bar{x}$	Significance % change	Group C <sup>1</sup> $\bar{x}$	Significance % change	Group C <sup>1</sup> $\bar{x}$	Significance % change
Tensile Strength (lbs./in <sup>2</sup> )	3462.3	1333.6	Sig (.01)	+88.5	2119.2	Sig (.01)	+63.4 Not sig (.05)
% Elonga- tion	112.9	280.9	Sig (.01)	-59.8	342.9	Sig (.01)	-67.1 Sig (.01)
							-18.1

1

Group A was inoculated with *Trichoderma* sp. and incubated on mineral salts agar for 44 days  
 Group B was not inoculated but incubated on mineral salts agar for 44 days with paraformaldehyde  
 Group C was not incubated (controls)

TABLE III

Susceptibility to *Trichoderma* sp. F469 and the Effect of the Mold Growth on the Tensile Strength and Percentage Elongation of a Polyvinyl Chloride Film Plasticized with Dioctyl Phthalate and Incubated at  $29.4^{\circ} \pm 0.6^{\circ}\text{C}$  for 6 Weeks on Mineral Salts Agar

Sample Number	Mold Growth <sup>1</sup>	Average Thickness <sup>2</sup> (Mils)	Tensile Strength (lbs/in <sup>2</sup> )	% Elongation
100	t	18.5	2312	375
101	0	24	2167	387.5
102	t	22	2272	350
103	t	13	2000	275
104	0	27.5	2174	350
105	t	19	1632	250
106	t	25.3	2126	425
107	0	16	2250	362.5
108	t	16.3	2012	325
109	t	22.8	2231	375
110	t	10.3	2308	325
111	t	17.5	2159	350
112	i	25.5	1797	287.5
113	l	27.8	2086	337.5
114	t	21.8	2294	387.5
n = 15			$\bar{x} = 2124.7$ $\sigma = 197.2$	$\bar{x} = 344.2$ $\sigma = 46.4$
Controls (not incubated) n = 15			$\bar{x} = 2264.4$ $\sigma = 155.4$	$\bar{x} = 361.7$ $\sigma = 23.3$

<sup>1</sup> Code for mold growth:

0 = no growth

t = trace of growth (less than 3% of surface moldy)

l = slight growth (3% - 10% of surface moldy)

<sup>2</sup> Thicknesses are those of specimens before exposure

TABLE III a

Comparison of Mean Tensile Strength and Percentage Elongation of Polyvinyl Chloride Film Plasticized with Diethyl Phthalate and Incubated on Mineral Salts Agar

	Inoculated <sup>1</sup> $\bar{x}$ (mean)	Unincubated Controls $\bar{x}$	Inoculated Compared to Controls Significance % change
Tensile Strength (lbs/in <sup>2</sup> )	2124.7	2264.6	Sig (.05)
% Elongation	344.2	361.7	Not Sig (.05)
			-6.2
			-4.8

<sup>1</sup> Inoculated with *Trichoderma* sp. and incubated for 6 weeks

TABLE IV

Susceptibility to *Trichoderma* sp. FA69 and the Effect of the Mold Growth on the Tensile Strength and Percentage Elongation of a Polyvinyl Chloride Plastic Film Containing Butadiene Acrylonitrile as a Plasticizer and Incubated at  $29.4^{\circ} \pm 0.6^{\circ}\text{C}$  for 6 weeks on Mineral Salts Agar

Sample Number	Mold Growth <sup>1</sup>	Average Thickness <sup>2</sup> (Mils)	Tensile Strength (lbs/in <sup>2</sup> )	% Elongation
19	0	11	2151	500
20	t	11	1545	437.5
26	t	19	2000	525
27	0	19	2052	487.0
30	t	18	2166	437.0
34	t	21	2047	462.5
35	t	21	2097	462.5
38	0	20	2150	512.5
39	t	14	1787	430
40	t	13	2076	432
41	0	14	1571	330
42	0	14	2428	500
43	0	14	1666	453
44	t	12	2285	510
45	t	21	2285	525
46	0	21	2285	525
Controls (not incubated)			$\bar{x} = 2022.9$	$\bar{x} = 473.3$
$n = 15$			$\sigma = 197.2$	$\sigma = 47.4$
Code for mold growth:			$\bar{x} = 1840.6$	$\bar{x} = 472.0$
$0 = \text{no growth}$			$\sigma = 203$	$\sigma = 38$
$t = \text{trace of growth (less than } \frac{1}{2} \text{ of surface moldy)}$				

<sup>1</sup> Code for mold growth:

$0 = \text{no growth}$

$t = \text{trace of growth (less than } \frac{1}{2} \text{ of surface moldy)}$

<sup>2</sup> Thicknesses are those of specimens before exposure

TABLE IV a

Comparison of Mean Tensile Strength and Percentage Elongation of Polyvinyl Chloride Film Plasticized with Butadiene-Acrylonitrile and Incubated on Mineral Salts Agar

	Inoculated <sup>1</sup> x Mean	Unincubated Controls x	Inoculated Compared to Controls	
			Significance	% change
Tensile Strength (lbs/in <sup>2</sup> )	2022.9	1440.6	Sig (.05)	+9.9
% Elongation	473.3	170.0	Not Sig (.05)	+0.7

<sup>1</sup> Inoculated with *Trichoderma* sp. and incubated for 6 weeks



A



B



C

WEL. 110306-1

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FIGURE 1

POLYVINYL CHLORIDE PLASTIC FILM PLASTICIZED WITH DIETHYL SEBACATE

A. BENTY GROWTH OF TRICHOSPERMA SP. ON TENSILE SPECIMEN INCUBATED ON MINEBIAL SALTS AGAR IN SQUARE BOTTLE FOR 3 WEEKS

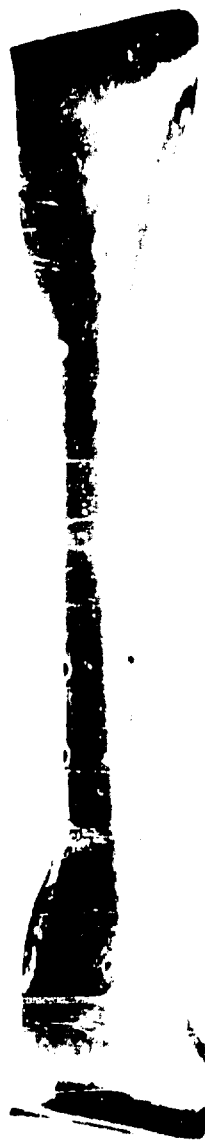
B. VIEW OF SPECIMEN AFTER REMOVAL FROM BOTTLE

C. INCUBATED SPECIMEN

ORD DEPT



A



B

C

REL. 11826-2

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- POLYVINYL CHLORIDE PLASTIC FILM PLASTICIZED WITH ETHYL PHTHALATE
- A. SPECIMEN INOCULATED WITH TRICHOMONAS SP. AND INCUBATED ON MINERAL SALTS AGAR IN SQUARE BOTTLES FOR 9 DAYS
  - B. SAMPLE REMOVED FROM BOTTLE SHOWING A TRACE OF MOLD GROWTH
  - C. INOCULATED SPECIMEN





A



B



C

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FIGURE 3

- A. SPECIMEN INOCULATED WITH TETROGENA SP. AND INCUBATED IN MINERAL SALTS AGAR IN 5" WARE BOTTLES FOR 9 WEEKS
- B. SAMPLE REMOVED FROM BOTTLE SHOWING A TRACE OF MOLD GROWTH
- C. UNINOCULATED SPECIMEN